

An Un-awaredly Collected Real World Face Database: The ISL-Door Face Database

Hazım Kemal Ekenel, Rainer Stiefelhagen

Interactive Systems Labs (ISL), Universität Karlsruhe (TH),
Am Fasanengarten 5, 76131 Karlsruhe, Germany
{ekenel, stiefel}@ira.uka.de

Abstract. In this paper we present a new face database that has been collected under real world conditions and without collaborating with the individuals whose images are being captured. The images in the database are recorded with a zoom camera monitoring the door of the laboratory. The developed capture software processes each frame and whenever it detects a face as well as the eyes, it saves the frame to the database. A face recognition software is also accompanied to the image acquisition system to help to label the identities of the individuals in the database. Recordings have been done for six months and this way ten thousands pictures of more than 100 individuals have been collected. From this set, approximately 33000 images of 30 people are made available to public. To give an idea about the difficulty level of doing face recognition under such a scenario, the well-known face recognition algorithms are tested on the collected database.

Keywords: Face recognition, face database.

1 Introduction

Due to tremendous interest in face recognition research, there have been many face databases become publicly available to comparatively evaluate the proposed face recognition algorithms' performance. For an overview of the well-known publicly available face databases, please see [1]. The availability of these databases is very valuable, since the results obtained on these databases provide insight about the face recognition problem. Up to now, the face databases have been collected mainly under controlled settings and contain controlled single variation source or combination of two variation sources (i.e. expression, illumination, occlusion, pose, time gap between training and testing data), to assess the face recognition algorithms' performance against these factors. Although these databases are quite beneficial to find out the algorithms' pros and cons against specific variation sources, they don't provide a cue about how the tested algorithm is going to perform under real-life conditions. The main reasons for this mismatch between the face databases collected under controlled settings and under the real-life conditions are:



- In the face databases, the variations on the facial appearance are produced by controlling only a single source or combination of two sources, however, in real world, these variations occur by the combinations of multiple sources.
- The face databases contain discrete variations, i.e. head poses at some specific angles. On the other hand, in real world, all kinds of pose variations and all kinds of expression, illumination variations at different strength levels can be encountered.

The other common aspect of the publicly available face databases is, they are all collected in a collaborative setting. That is, the individual is informed to stay in front of the camera and he/she is quite aware that his/her image is being recorded. This data collection setup is reasonable and useful for the authentication task, since it imitates the authentication scenario. Nevertheless, it's incapable to address the surveillance task, because there exists no collaboration between the data collection system and the individual in the surveillance task.

This paper presents a new face database that has been collected by taking into consideration these facts –the mismatch between the face databases and real world conditions and current face databases' incapability to imitate the surveillance scenario. The database is collected with a zoom camera monitoring the laboratory's door as illustrated in Fig. 1. The developed capture software tries to detect the individuals who enter the room by using face and eye detectors. If both the face and eyes are detected in the image, then the image is saved to the database. To speed up the classification of the individuals in the database, a face recognition system is also accompanied to the capture software.

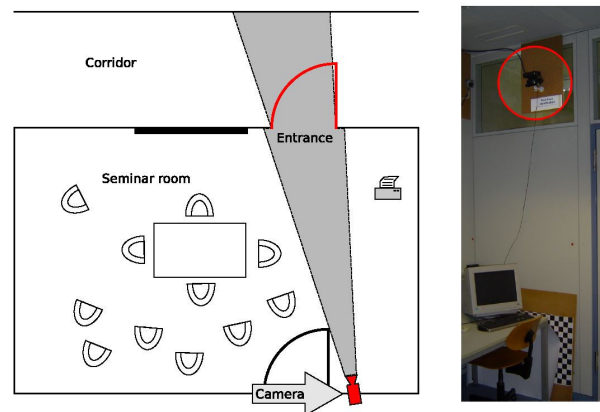


Figure 1. Room layout and camera setup

The main motivation to build a data collection system to monitor the people entering the room is the wide range of applications that it can be used in. Both for surveillance of public areas, e.g. airports, and for people monitoring in smart environments, e.g. smart homes, one of the best instants to identify the people is the instant they are entering the room. This provides high resolution face images, since the field of view is restricted to the only upper part of the door. It facilitates face

detection by providing high resolution face images, relatively less faces to detect and less cluttered background (i.e. with respect to an airport hall where a face detection software is expected to detect many faces at the same time in a very cluttered scene). Moreover, the head pose variations are also limited in this scenario.

The organization of the paper is as follows. In Section 2, the data collection system is described. The detailed information about the database is given in Section 3. In Section 4, experimental results of the well-known face recognition algorithms are presented. Finally, in Section 5, the conclusions and future plans are given.

2 The Data Collection System

The data collection system consists of a personal computer, Canon VC-C1 pan-tilt zoom camera and the detection software. The camera is zoomed to view the upper part of the door and acquires 25 frames per second. The recorded images are saved as “.bmp” file format and they are color images of 640x480 pixels resolution.

The object detection algorithm used for face and eye detection is based on cascaded haar classifiers [2,3]. The input image is first processed by the publicly available frontal face detector provided by the OpenCV library [4]. However, this face detector provides many false detections. To prevent these false detections, we processed the found face rectangle to check for the eyes with our eye detection algorithm. If both of the face detector and eye detector validate the existence of a person, the frame is saved to the database. Fig. 2 illustrates the data collection system.

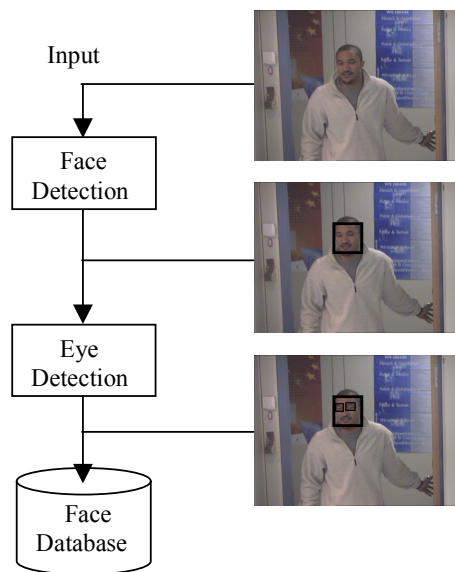


Figure 2. Data collection system

3 The ISL-Door Face Database

The face database has been collected by running the data collection system during the work hours, for six months. The initial recordings were done in February 2005, and the later recordings were done during August-December 2005. There has been no restriction or control imposed on the environmental conditions. The database has been collected under completely unconstrained conditions and without collaborating with the individuals whose images are being captured. The sample images from the database are shown in Fig. 3.



Figure 3. Sample images from the database

Ten thousands pictures of more than 100 individuals have been collected during 86 recording days in six months. 16 days of recordings were done in February and 70 of them were done during August-December 2005. Around 33000 images of the 30 individuals in the database are made publicly available. These people are the members of the Interactive Systems Labs who have been informed in advance about the ongoing recordings. All these individuals signed a visual data collection consent form stating that they have been informed about the recordings. The frames that contain individuals who did not sign a consent form are removed from the database. Each individual has different number of samples, ranging approximately from 150 to 2900, depending on their frequency of visits to the laboratory. 26 of the individuals are male and 4 of them are female. The main variations that exist in the database are:

- Face resolution,
- Head pose,
- Expression,
- Illumination,
- Occlusion,
- Time gap.

Sample images from the same individual showing these variations can be seen in Fig. 4. The face resolution varies approximately between 60x50 pixels and 120x100 pixels. The encountered head poses are generally close to frontal and vary between frontal and right profile. The expressions in the database are mostly neutral, smiling and talking. There exist uncontrolled ambient illumination conditions and the illumination on the face varies with respect to the location where the person stands, i.e. in the corridor, at the door, in the room. Occlusions occur mainly when the person starts to enter the room due to the wall. It also occurs due to hands on the face or due to accessories. The time gap between the initial recordings and later recordings is six months.

Besides the images containing the faces of the individuals, the corresponding automatically detected face locations and eye centers are also available in the database. These automatically generated labels have been validated by a human, and the false detections have been corrected manually.



Figure 4. Sample images of an individual

4 Face Recognition Experiments

To give an idea about the difficulty level of doing face recognition under such a scenario, we tested our face recognition algorithm [5,6] as well as the other well-known face recognition algorithms, eigenfaces [7,8], Bayesian face recognition [9], Fisherfaces [10] and embedded hidden Markov models (EHMM) [11] on the collected database. In the experiments, out of 33053 images of 30 subjects, 18820 of them, that correspond the previous recordings were used for training. Remaining 14233 images, which have recorded later were used for testing. 1046 images from the training set were used for constructing the eigenspace. The same feature vector dimension, 320, was used for local appearance-based face recognition, Bayesian face recognition and eigenfaces approaches. The images were aligned with respect to automatically detected eye locations and scaled to 64x64 pixels resolution.



Figure 5. Sample individuals from the database

The experimental results are given in Table 1. The best performance is achieved by the local appearance-based face recognition approach with 82.8% correct recognition rate. Fisherfaces algorithm follows it with 79.6%. As already shown in the literature eigenfaces algorithm using MAHCOS distance metric performed better than L1. Embedded hidden Markov models obtained the lowest performance. These results show that it is more difficult to handle the variations that one can confront in real world. However, the results are at the same time encouraging, since by the usage of additional information, e.g. video data, it is possible to do robust face recognition under real world conditions.

Table 1. Correct recognition rates of the algorithms

Method	Correct recognition rate
Local Appearance Face Recognition [5,6]	82.8%
Bayesian Face Recognition [9]	73.3%
Fisherfaces [10]	79.6%
Eigenfaces MAHCOS [7,8]	74.0%
Eigenfaces L1 [7,8]	68.3%
EHMM [11]	51.1%

5 Conclusions

In this paper a new face database, that has been collected under unconstrained conditions and without collaborating with the individuals, is presented. We believe that this database will provide important insights about face recognition problem under real world conditions. As a future work we are planning to construct, again automatically, a video-based face database that contains the video segments of the individuals while they are entering the room.

6 Obtaining the Database

Anyone interested in using the database should sign and fax/mail the provided license agreement form. Upon the receipt of the license agreement form, the database can be either shipped or downloaded. To get more details on how to obtain the database, please visit the database's website: http://isl.ira.uka.de/face_recognition/doordb.html.

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